

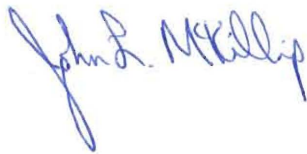
*Preventing Break-Down and Maintaining Efficiency:
An Honors Experience in Preventative Maintenance*

An Honors Thesis (HONR 499)

by

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Abstract

Preventative maintenance is of the utmost importance in any type of manufacturing plant, but with food manufacturing this is true to an even higher extent. Equipment that is not properly maintained could break down during a run and contaminate food with foreign materials. Having a well-organized preventative maintenance program is not only vital to retain food safety, but it is a requirement of all auditing institutions. Food manufacturing is harsh on equipment and without proper upkeep they are bound to fail at the most inconvenient times. Working at JES for the two previous summers has shown how important it is for the equipment to be functioning at full capacity at all times. Using the KeepTrak program purchased by JES, I designed a simple, yet effective, program to manage the vast amount of equipment according to standards set by the Safe Quality Food Institute, United States Department of Agriculture, Food and Drug Administration, and the Hazard Analysis and Critical Control Point plan developed by JES.

Acknowledgements

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I would also like to thank Jeff, Dave, Steve, Lori, Cynthia, and all the JES Foods, Inc. employees for working with me to successfully complete this project.

Project Rationale

For my senior honors thesis, I had the opportunity to make a big difference in the everyday operations of an established company in my hometown. Being able to make a contribution to the functionality of a successful company was a perfect way to cap off a four year honors experience, while also integrating some of the knowledge obtained in my major studies. This project did not specifically relate to a biology major and chemistry minor, but it challenged the critical thinking and problem solving skills developed through these areas in new and exciting ways. When thinking about what would work well as a capstone project, I was certain that I wanted to make a physical impression on someone other than only myself.

JES Foods, Inc. (JES) is a small food processing plant located just off the shorelines of Grand Lake St. Marys in Celina, OH. As an associate working full-time at JES Foods, Inc. during the summer of 2013, I established an effective preventative maintenance (PM) program to assist in overall systems operations. JES Foods, Inc. was actively seeking Safe Quality Food Institute (SQF) Certification and I assisted them in satisfying several requirements of the program. **Appendix A** describes the needed requirements of developing, documenting, and implementing a preventative maintenance program. My primary goal for this experience was leaving the company with an end result that can be incorporated into their Hazard Analysis and Critical Control Point (HACCP) plan, utilized in everyday operations immediately upon implementation, and continued to be elaborated on into the future without much additional effort.

A successful preventative maintenance program is a requirement for SQF certification, as well as United States Department of Agriculture (USDA) and Food & Drug Administration (FDA) regulations for food safety. After working in this same establishment for the previous two summers, I cannot stress enough how important a quality maintenance staff is for this company to run smoothly and safely. Daily operations use multiple different machines and the machines are placed under huge stresses because of the nature of the operations. For example, in the kettle room of the plant the humidity level is probably constant around 80-90%. This is torture for the equipment used in this and other areas of the plant. Establishing a quality preventative maintenance program for this company led to less downtime and better functionality of machinery, ensuring food safety and minimizing the risk of product contamination.

A PM program has major impact on the JES HACCP plan by reducing potential contamination and ensuring product safety. A multitude of the HACCP requirements are met or maintained by having a well-functioning PM program. The following list shows all the requirements of the JES HACCP plan that are satisfied by this project.

1. The building must maintain a positive air pressure at all times. Also, filters need to be cleaned or replaced regularly to reduce airborne contamination.
2. Checkpoints must be established to control foreign material contamination, such as damaged equipment, loose screws, flaking rust, and broken glass.

3. Food Grade grease and lubrication is the only type to be used. Also, lubricants must be allergen free and always used appropriately because excess grease acts like glue to potential contaminants.
4. Waste-Operating drains & scheduled grease trap cleaning must be established to prevent drain back up.
5. Pump seals must be replaced regularly to reduce leaking, cross contamination, and adulteration.
6. Overhead leaks must be prevented because they could contaminate product or contact surfaces.
7. All welds must be smooth and all surfaces cleanable to prevent formation of biofilms.
8. A back-flow prevention plan must be in place and maintained.
9. Appropriate lighting must be installed and maintained to allow for functional inspection of areas and optimal equipment cleaning.
10. General structures need to be maintained to eliminate potential harborage & contamination areas.
11. Ready-to-eat (RTE) areas and equipment must be free of harborage points, such as bad welds or hard to clean areas, in order to prevent potential contamination.
12. Damaged and leaking equipment must be repaired immediately.
13. Maintaining boilers is absolutely imperative because the most common CCP is temperature.

14. Air Compressors need to be properly maintained so that all air-powered equipment runs correctly and product is always properly processed.
15. Fork lifts and other transportation equipment must be maintained to prevent contamination resulting from fluid leakage.

The preventative maintenance program was designed to allow JES to anticipate issues and prevent them. This program shows trending and can be analyzed to provide corrective actions before major issues happen. Trending also shows where the focus needs to be for continuous improvement.

JES purchased a computer program, called KeepTraK, which assisted me in my preventative maintenance organization. KeepTraK produces reports and notifies when maintenance services are needed for every piece of equipment in the plant. A multitude of reports can then be generated using this program and there will be a large volume of information this company has never easily had access to, allowing preventative maintenance activities to be documented and verified in a yearly audit. **Appendices B-O** are example reports generated using KeepTraK. These reports allow the company to trend maintenance activity and easily observe points where improvement is needed. Several permanent employees were also trained on how to keep the preventative maintenance program running smoothly and effectively in order to meet all standards set by the various certification organizations (SQF, USDA & FDA).

Another aspect of a successful preventative maintenance program is establishing proper Lockout/Tagout procedures for heavy equipment. Obviously, JES has its own policies for each piece of equipment in the plant. However, the company continues to grow and expand and with this comes new equipment needing acceptable

Lockout/Tagout procedures. Towards the end of the summer I began updating their standard procedures for each piece of equipment within the plant by following OSHA guidelines for this project. Along with developing these improved operating standards, there were also many discussions with other employees about using quality and safety within everyday practices to prevent unnecessary downtime and possible product adulteration. A working knowledge of the equipment within this organization is vital for better understanding of everyday operations and overall safety of each employee and product. The following is a summary of the work accomplished organized in chronological order.

Bi-weekly Summaries

Weeks 1-2

The first and second weeks were mainly dedicated to establishing a PM regiment for pieces of ventilation (HVAC) equipment within the building. Hours of researching through manuals and several meetings were undergone with management to discuss the preventative maintenance schedules for the equipment. Also, pictures were taken of each piece of machinery and a map was developed to assist the maintenance staff in locating each respective piece of equipment throughout the building.

One issue that was requested by the maintenance supervisor was developing a numbering system of all equipment throughout the plant. Over the years, several maintenance supervisors had numbered machines in different manners and this has led to much confusion and frustration. A new and efficient system was developed to be implemented throughout the entire plant. The numbers on each piece of equipment also

correlate with the asset number within company records, which allows for detailed expense reports to be kept on each item. Numbered tags were manufactured and permanently affixed to each piece of equipment in order to have a clear system for reference. HVAC equipment was the first to be labelled because of the importance of an organized maintenance schedule on these units. The company recently paid large sums to a local company to bring many HVAC systems up to proper operation and it is vital they do not sink below the current level of performance.

As this first main project wrapped up, I began updating and correcting the PMs created previously. Management, maintenance staff, and myself had another meeting to discuss a "PM Board" that I thought up in order to post daily and weekly PMs there in list format. Obviously one of my goals was to make the PMs very user friendly and easy to understand and record. A small trial with the list format was tried on the boilers within the plant during the first week and the maintenance staff expressed approval.

Weeks 3-4

As week four came to an end, I was pretty satisfied at the progress made. Weeks three and four were dedicated to many tasks and the maintenance crew began to "buy in" to the program. Nearly all pieces of equipment on the roof had been clearly labeled with a stainless steel tag riveted into place. Also, one unit had already been serviced and the maintenance supervisor greatly appreciated the new label tags and roof map developed for HVAC equipment on the roof.

Week three brought a new project of organizing operation manuals, purchase orders, and other maintenance documents stashed in their filing cabinets for years.

Although this was tedious and dull work, it was necessary in order to develop the proper preventative maintenance programs for the company's equipment. It seems the maintenance crew had much more information than they realized and I was determined to make it easier for them to access.

In order for maintenance to cooperate with me, I had to understand their wants and needs and make the recording of their work as easy as possible. Several talks with the supervisor made it clear that he wanted as little paper to fill out as possible. To accommodate that request, I developed a system of clipboards with lists for them to record the preventative maintenance activities that must be done on a daily or weekly basis. It was my goal to have ways for them to record their achievements efficiently and easily. On week three, the entire plant had a meeting on record keeping which showed just how important documentation is in a food manufacturing company. Everything must have a paper trail!

Next, I began encouraging maintenance to make it a habit to record their activities because it was not a very difficult task to complete but vital to the success of the program. I continued to ask them for suggestions to make that undertaking even more convenient. It was satisfying to see them start to see the convenience in what I was developing. At last, they were beginning to understand it was my goal to make their work day easier.

Weeks 5-6

The project continued to stay pretty much on track at this point, and I was on pace to finish it up on time. Weeks five and six were a little hectic for a few reasons.

First, week five was a short one and I had just returned from Appalachia Service Project in Kentucky, so it took me a little while to get back on track. Also, the plant manager took week five off and things around the plant were somewhat disorganized. Finally, I had the opportunity to travel on Monday & Tuesday to train a new company on a piece of equipment we had recently sold to them. Even with all of that, the project continued to progress. I had finally finished going through the equipment manuals and the maintenance staff was satisfied with their organization. In the next couple of weeks, I planned to make several small tweaks to the organization system in order to cross reference the filing cabinet with the equipment list on the computer.

I used part of week six to update the equipment list on the computer because the company had been buying and selling several pieces of equipment. In week seven, I planned to meet with management in order to completely remove several items from the list that I felt should no longer be listed. While updating the list, I also updated locations of all equipment to the correct spot and incorporated these updates into the PM program. Week 6 was slow and production did not come in on Monday, so I was able to go out and label the most used equipment with metal tags during their absence.

Over fifty pieces of equipment were labeled throughout the plant with stainless steel tags riveted into place. This labeling method would be continued beyond my project because of the constant acquiring of new equipment. The numbering system worked quite well and I received significant positive feedback from both maintenance and office workers about how it made their jobs more synchronized and convenient. The maintenance staff continued to make progress on the PMs and in week seven I began assigning them approximately three tasks per day in order to ease them into the

program. I was also starting to complete whatever preventative maintenance I felt confident enough to proceed with myself.

Heading into week seven I had several remaining small projects I hoped to finish before the conclusion.

1. Develop a labeling system for the cooling units within the plant, much like was previously done for the HVAC equipment
2. Continue to work with maintenance as they adjust to this new program and help them reach the point of optimal efficiency

Weeks 7-9

With two weeks of work time remaining, I was very satisfied with what had been accomplished up to this point. Weeks seven, eight, and nine were very productive. The maintenance staff really began to buy into the program and they were developing the useful and necessary habit of documenting their work. Each week the program became more and more detailed and was now to the point of covering all of the most frequently used equipment throughout the plant.

The biggest task I completed during these weeks was data compilation. I went back over more than a year's worth of work orders that the maintenance staff had completed and input appropriate pieces of this data into the program. Having this data inserted allowed for reports and histories for each PM to be created. This was what management desired most out of this project and I printed off multiple reports to which they responded to with satisfaction. These preventative maintenance histories will be handed to auditors and other inspectors in order to show the equipment has been

maintained appropriately and should not pose any risk to food safety. Having data input into the program was a very accomplished feeling because the program could now be used to its full potential.

Several days of week eight were devoted to updating the various preventative maintenance tasks that maintenance had requested to change. I also attempted to reduce the steps to as few as possible in my attempt to keep everything simple. As I said before, it was of vital importance to keep this project streamlined and straightforward. Anything over complicated would not be utilized. Management began reinforcing my requests of maintenance by keeping track of how many tasks I assigned per week and how many were returned. Management involvement boosted cooperation and everybody was now working together to ensure the success of the PM program.

In the final weeks, I labeled the remaining equipment that I had made tags for. Also, I educated others on how the PM program works so that it could be handed off without any issues. Obviously, data will be input daily and I printed out all of the paperwork, so JES had a physical product to match up with the computer program.

Current Update

Since my departure in August, JES has continued to work with the PM program and the maintenance staff has really embraced the new organizational strategy of their work. Several new employees have come into the maintenance staff at JES and they have no problem understanding the program and understanding what is required of them. In October, JES underwent their most recent audit under the SQF 2000 guidelines. I can proudly say that they passed this audit and are now SQF certified!

When I heard this news I was absolutely thrilled. Working at JES for several summers gave me perspective for how important this certification was and it was my first priority to help them in gaining this certification by developing the PM program. The maintenance department did not lose a single point during the audit, neither in performance or paperwork. There could be no more satisfying feeling than making this kind of difference in a real world company. To me, there was no more worthwhile way to conclude my honors experience at Ball State University.

Appendices

Appendix A: Safe Quality Food Institute 2000 guidelines for preventative maintenance

Appendix B: JES Foods, Inc. preventative maintenance catalog

Appendix C: People and resources

Appendix D: Preventative maintenance list

Appendix E: All preventative maintenance reports

Appendix F: Sorted equipment information

Appendix G: Equipment information for Reznor roof air handler

Appendices H-J: Specific completion histories for most often used equipment

Appendix K: Work to do August 15, 2013

Appendix L: Work to do between August 15, 2013 and November 1, 2013

Appendix M: Total PM compliance record

Appendix N: PM compliance record from May 20, 2013 to August 15, 2013

Appendix O: PM compliance record from July 12, 2013 to August 15, 2013